

FIG. 1

09/643,876 2/47 FEB 0 3 2003 Plant Name TATO TRADE Address City State General Zip Informa Phone tion Fax Contact User Size Industry # of pumps/mixers # of seals per pump # of sealed stuffing boxes in Plant % of pumps sealed % of pumps packed Average seal list price % of seals purchased new annually % of seals purchased as factory repair or rebuild kits Factory repair/rebuild price as a % of new seal price annually Plant % of population requiring solid shaft seals Profile Avg. shaft seal size (in inches) in plant # of Pumps, Mixers, Flushed With Seal Water into # of Pumps, Mixers, Stuffing Boxes which are flushed with seal water which require evaporation later on. (Ex. Dilute black liquor pumps in pulp & paper Proposed Estimated Annual Seal Expenditure. industry. (Revised Plant Estimate New Seals Only) Average Seal List Price Per Seal Average Cost of 1 hour of Labor With All Benefits RECEIVED FEB 0 5 2003 Average Cost of Shaft or Sleeve Damage Included Avg. Cost for Bearings, Lip Seals, Gaskets, Etc. Additional Cost of Seasoned Trained Professional vs. **GROUP 3600** Cost Per Seal Per Year For Housecleaning (Please Novice Per Hour Annual Cost Of Production Dowtime Estimate) Actual/Estimated Plant Cost for One Failure Cost of Electricity Per Kilowatt Hours Average Cost Of Packing Set Informa Cost of Seal Flush Water Per 1,000 Gallons Evaporation Cost of 1 Gallon of Water

Cost of 1 million BTUs

tion

2A FIG.

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| Ex. If Plant Seal Water Costs Are .15/1000 gallons and effluent treatment costs are .75/1000 gallons .75/.15 = 5 | |
|--|---|
| Avg. Cost of Product/Gal. (Please keep in mind that fluids like condensate have a cost and should be included) | |
| Avg. Labor Cost of Unscheduled Repairs & Maintenance & Operations Combined) | - |
| Production Cost of Machine Time Per Hour (Ex. Paper Machine) | |
| Cost of Housekeeping Service/Hours | |
| Split & Unsplit Average Price For Single W/Flow Meter or Double Seal Per Inch (Shaft Sleeve Dia.) | |

FEB 0 5 2003

GROUP 3600

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| | | Piant | # of Seals | | | | Dec | rease | n Sea | Decrease In Seal Life Due To Seal Design Deficiencies Which Increase LCC (Life | Jue Ti | Seal | Desi | gn De | ficient | ies W | hich I | ncrea | se LC | C (Life | Cycle | Cycle Cost) | | DEMA | 2003 | , |
| | | Seal Popula ion | Seal In Populat Plant ion | Inferior Rotary Design | | inferior Unbalan ced Design | | Inferior Double Seal Design | | Inferior Face Material | Inferior Tight Clearanc e Design | | Unreli able Install ation | | Spring Failure When Immerse d in process | - WILL 2 U UN- | Metal Bellows Failure When Immerse d in process | Rotary Face Under Tensio n | | Inferior Gland Flush Design | Other Deficie ncies From F&B Chart | ie Decreas le in Seal Life For Model | % seas Press | . ο υ | 1 | igs) |
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| · | \$ | | | Est. | Pit Est. % | "St. "St. | Pit Ir | Ind. Plt Est. Est. % % | t ind. | Est % | Fist. | Est. E | Fist. E. E. | Pit ind Est. Est % % | Ind. Pit Est. Est. % % | t Ind. % Est. | Sist P | Est 8 | PIt Est. E | Ind. Pit Est.Est. % % | Ind. Est. % | Pit Est. % | | | | , |
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| Seals | | | | | | + | + | | + | \prod | | 1 | ++ | + | + | + | \parallel | \parallel | ++ | + | \parallel | | + | | /47 | - 1 |
| Cart. | | | | \prod | | H | H | H | \coprod | | | | $\dag \uparrow$ | | H | \coprod | \coprod | | $\dag \uparrow$ | H | | | H | | | - / |
| Seals | | | | | | | H | + | ++ | $\frac{ }{ }$ | \$ - | \prod | $\dag \dag$ | + | $\frac{1}{1}$ | \coprod | \prod | \Box | | | | | \parallel | | | • ′ |
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| Comp. Seals | | | 0 5 | | | \vdash | \vdash | | \vdash | | | \prod | H | $oldsymbol{+}$ | onumber | - | | | \dag | H | | | + | | | |
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| Other Seals | | 00 | | | | | | | | | | | | | | | | | | | | | | | | |
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| Plant Seal Population | on on | 100 | 200 | | | | Avera Desig | Average Decrease Design Deficiencie | creas | e in Seal Life For The Entire Plant Seal Population Due to Existing ies:% | al Lif | e For | The E | ntire | Plant | Seal F | opula | Ition [| ue to | Existi | Bu | 455 | | 49.49% | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | |

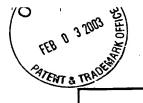
FIG. 3

| FEB 0 3 | 2003 | | 5/4 | 7 | | |
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| PARTS TRA | | omatically lding them associated due to the pecificatins al world | | Specificati ons Good/No Good | No Good Value: .017 | |
| | ebi Milih Me | n the field aute ment mfgs ho t and all costs lete over time suply these s iil demand res | | | Example: Seal Mfg assumes responsibility for performance | |
| | em on a check list The supplier of product responsibility identifier | This section when completed in the field automatically feeds information back to equipment mfgs holding them responsible for life of the product and all costs associated with it. This may become obsolete over time due to the fact that mfgs will not be able to suply these specificatins in the future as customers will demand real world solutions. | Seal Mfg. Specifications | What to Check What to Check Accountable Against Against Party Signoff | Manufacturers Specifications: Stuffing Box Face Perpendicularit responsibility y - for Commended performance | |
| | This is one example of one item on a check list | This section w feeds informati responsible for with it. This m fact that mfgs w in the future | Pump Mfg. Specifications | What to Check Against | Manufacturers Specifications: Stuffing Box Face Perpendicularit y - Recommende d .007" TIR | |
| | example of | o identify I decisions S, etc. The ndicator to nich up until | st | When To Check | 5 Performed in shop before equipment is disassemb led. | .020 - |
| | his is one | workers to ch drive al ise of part sal world is ctancy wh | al/Checkli | ŧ | | .010 - .020 |
| | | front line s field which and purche at as the re elife expe | Knowledge Based Pictorial/Checklist | | | .005- |
| | | st enables ions in the rhebuild a ecklists ac fiic precise only obtain | ledge Bas | | | .002 .005 |
| | | This checklist enables front line workers to identify existing conditions in the field which drive all decisions regarding repair/rebuild and purchase of parts, etc. The equipment checklists act as the real world indicator to arrive at scientific precise life expectancy which up until now was only obtained in labratory conditions. | Know | Verification Method | Use a dial indicator to verify perpendicularity between the stuffing box face and the shaft O.D. | 0002 |
| | 44 | 48 | | | RECEIVED FEB 0 5 2003 GROUP 3600 | Actual |
| | | | FIG | 4A | | |

FIG.

| FEB 0 3 | 2003 E | | | , | 4 . | , | / 6/ | /47 | | | | | | | | | | |
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| | Mfg is held accountable | | = the recorded value that applies to | your organization. | | | · | | | , | | | | | | | | |
| | | | • = the record | no k | : : | | | | | | | | | | | | | |
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| | 45 days | | | | | 0 | 200 | | | | | | | | | | | |
| | 121 days | | | | , | 0 | 100 | | | | | | | | | | | 40 |
| · | 196 days | | | | | 0 | 75 | | | | | | | | | | | 1 |
| | 386 days | | | | | 0 | 20 | | | | | | | 5 | | | ano lend | 1 |
| | 912 days | | | | | 0 | 25 | | | | | | | | | 6 5 20 P 3 | | 0 |
| · | | Single Design | Double Design | Cartridge Design | Component Design | Stationary Design | Rotary Design | Balanced Design | Unbalanced Design | Tandem Design | Back to Back Design | Internally Mounted Design | Externally Mounted design | Large Clearance Design | Tight Clearance Designs | Dbl. seal with pumping ring design | Double seal without pumping ring design | |
| | | اره | | 10 | آ | 100 | <u> </u> | | ات | Cartri | ට වි | Com | ב ב | 1 | | | | |
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FIG. 4B



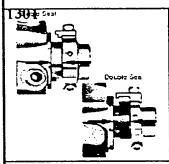
Seal Failure Analysis Inspection Form

To perform a seal failure analysis, you have been provided photos for all seal types typically found in service. Simply click on the photo(s) that best identifies the conditions of the seal you are analyzing.

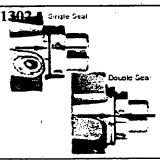
After all applicable pictures have been selected, click on the "When Failure Analysis Is Complete Click Here To Go To Seal Failure Analysis Report and Add Additional Comments/Notes If Required." button to continue.

If safety issues allow, inspect parts before and after cleaning as photos require.

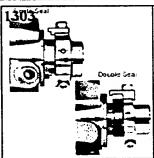
Cartridge Seal: Seal Settings



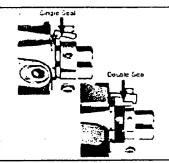
Incorrect settings due to seal being over compressed: Gap between lock collar and gland is too large. (Axial Direction)



Incorrect settings due to seal being under compressed: Gap between lock collar and gland is too small. (Axial Direction)

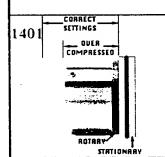


Incorrect settings due to gland face to shaft/sleeve not being perpendicular.

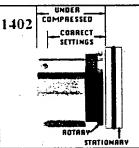


Incorrect settings due to shaft/sleeve being off centered to gland. Radial off-centering (up. down, left or right) between shatt/sleeve and gland ID

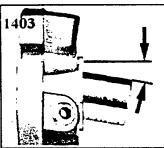
Component Seal: Seal Setting



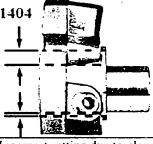
Incorrect setting due to seal being over compressed: Setting of rotary unit is wrong causing the scal to be over compressed.



Incorrect setting due to seal being under compressed: Setting of rotary unit is wrong causing the seal to be under compressed.



Incorrect setting due to gland face to shaft/sleeve not being not being centered to shaft. perpendicular.



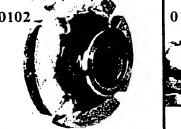
Incorrect setting due to gland

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Cartridge Seal: Environment

0108

Seal area packed with product



Seal gland packed with product

Carbon dust visible on front or ID of gland.



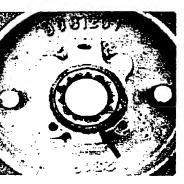
Crystalization/Solidification of product on atmospheric side of gland

FIG.



Click her to identify the most; probable 2 casue of

failure



Seal area packed with product

Reason

Cause

Verification

Corrective Action

Thermal sensitive fluids are not state in the seal area, causing it to build up on seal components

Cartridge: Seal chamber maintained in liquid temperature is raised or lowered beyond the solidification - point of the process fluid.

Cartridge: Verify the actual solidification point of the process fluid and the temperature maintained in the stuffing box seal area.

Cartridge: Review materials of construction recommendations. Review API plan and heating and cooling plan recommendations to control seal environment.

pack up in the seal area and on the seal components

Cartridge: Undissolved solids Heavy concentration are allowed to accumulate in the seal area.

Cartridge: of undissolved solids Verify concentration of the % of solids present in the process stream.

Cartridge: Review materials of construction recommendations. Review API plan and heating and cooling plan recommendations to control seal environment.

Undissolved fibrous solids pack up in the seal area on the seal components

Cartridge: Heavy concentration of fibrous solids are allowed to accumulate in the back cover/stuffing box.

Cartridge: Verify concentration of the % of solids present in the process stream.

Cartridge: Review materials of construction recommendations. Review API plan and heating and cooling plan recommendations to control seal en

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Thermal cycling resulting in premature seal failure.

Inferior Casing Design For

Please confirm that an inferior casing design Temperature Control for temperature control is being used.

Replace GROUP 3600 casing design for temperature control.

Thermal sensitive fluids are not state in the seal area, causing it to build up on seal components

Component: Seal chamber maintain d in liquid temperature is raised or lowered beyond the solidification point of the process fluid.

Component: Verify the actual solidification point of the process fluid and the temperature maintained in the stuffing box seal area.

Component: Review materials of construction recommendations. Review API plan and heating and cooling plan recommendations to control seal environment.

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| | | Decide on Repair/ Rebuild of product or service | Work Individu Force al Skill Avera Level ge | Level | 9 | | | | |
| 62 | | 5 (0 | Individu al Skill Level | Ma | • | | | | |
| ζ | | Perform Analysis | | 우 든 | | | | | |
| Skill Level Available | | Pe | | Level | | | | | |
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| Skill | S | A Info | Mork Individu Force Individu al Skill Avera al Skill Level ge Level Skill | reve | | | | | |
| | | ng n | Individu al Skill Level | Mas | | | | | |
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| | | Gather Information To Make Purchasing Decision | Work Force Averag e Skill Level | | i, | | | | - |
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| | , | | | | | Product/Ser vice Skill Level Rating Required (Example: A Component Mechanical Seal) | | | |
| | | 6A 6B | 9 | | Ş, e | RECEIVED FEB 0 5 2003 GROUP 3600 | Single Design Double Design | Cartridge Design Component Design | Stationary Design |
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FIG. 6A

| <u> </u> | | | | | | | | | | | | | | | | | | | | | | | |
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| Rotary Design | Balanced Design | Unbalanced Design | Tandem Design | Back to Back Design | Internally Mounted Design | Externally Mounted design | Large Clearance Design | Tight Clearance Designs | Double | Double seal without pumping ring design | | High Balance Ratio | Low Balance Ratio | Spring Loaded Design | Metal Bellows Design | Light Spring Load Per Square | High Spring Load Per Square Inch | Wide Face Width | Narrow Face Width | | Single Seal with Large Dual Tangential Flush Holes | ngle | , 울 |
| 8 | <u> </u> | احًا | <u> </u> | l _® | 트 | <u> </u> | <u> </u> | oo : | onent Double seal with pumping ring | <u>E</u> | П | Ī | 의 | Š | Ž | ءَ تَــٰ | T S | _ ≥ | Ž | H | <u> S</u> | S ff. | Comp Drill Holes Or No Flush Holes |
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FIG. 6B

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| onent Double seal with two flush holes on same surface Double seal with two flush | holes 180 degrees apart | 316SS Metallurgy | ials Cartri of dge & Alloy 20 Metallurgy | const Comp ructio onent Hastelloy C Metallurgy | Titanium Metallurgy | | r & Cartri Practice of using OEM certified dge & glands in repair/rebuild Comp Proc onent edur edur | certified glands in repair/rebuild |
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GROUP 3600

STONE BEEF

12/47

| Seal Type C1 & C2 require double seal | 316 SS | Double | | | | | | | | | | | | | | | | | | | |
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| Sea C1 dou | | e e e e e e e e e e e e e e e e e e e | | | | | | | | | | | | | | | | | | | |
| | - | Operating Conditions System Recommendations | | T-9;9t;9 | Seal Attributes | | | | | | | | | | | | | | | | |
| | c | Acetone; Tem <210 F | | | | | | | | | | | | Practice of using OEM certified faces in repair/rebuild Practice of not using OEM certified faces in repair/rebuild | One Piece Carbon Soft Face Material Under Compression | One Piece Carbon Soft Face Material Under Tension | Two Piece Carbon Soft Face Material Under Compression | Two Piece Carbon Soft Face Material Under Tension | Practice of replacing soft seal faces on cartridge and component seals. | Practice of reusing relapped soft seal faces on cartridge and component seals. | |
| 7E | 7F | | | | | Aodel | etallurgy | Metallurgy | ctaliuigy | ıllurgy | etallurgy | etallurgy | | sing OEM c tot using OE | arbon Soft | arbon Soft F | Carbon Soft | Carbon Soft | eplacing sof | eusing relap | |
| 22 | 70 | 92 | | 02 . | | Seal Mfg/Model | Alloy 20 Metallurgy | Hastelloy C Metallurgy | i italiiulii ivictaliulgy | | Alloy 20 Metailurgy | Titanium Metallurgy | | Practice of 1 Practice of r | One Piece C | One Piece C | Two Piece (| Two Piece (| Practice of r | Practice of r | |
| 7.A | 78 | 1 | | wation | | 100 | e & | Compo | -11 | Material Cartridg | 8 e & | nent | | | | | | | | | |
| | | Process Fluid | | Seal Inf mation | | 5,500 | | <u> </u> | IIOII | | ves s of | | | | | R | | C EB | 0 5 | VEI 2003 | |
| | | F | IG. | 7/ | | | 5 | 2 Clands | | ā | Sieeves | Barrels | <u>\</u> | 2_ | | G | R | 0 | UF | 36 | 00 |

| | One Piece Ceramic Hard Face Material Under Compression | | | | | |
|-------------|---|-----|---|-----|---|---|
| | One Piece Thin Walled Ceramic Hard Face Material Under Tension | | | | | |
| | Two Piece Ceramic Hard Face Material Under Compression | - | | | | |
| | Two Piece Ceramic Herd Face Material Under Tension | | | | | |
| | One Piece Plated TC Hard Face Material Under Compression | | | | | |
| | One Piece Plated TC Hard Face Material Under Tension | | | | | |
| | Two Piece Plated TC Hard Face Material Under Compression | | | | | |
| | Two Piece Plated TC Hard Face Material Under Tension | | | | | |
| | One Piece Nick. Bonded TC Hard Face Material Under Compression | | | | | |
| | One Piece Nick. Bonded TC Hard Face Material Under Tension | | | | | |
| rtride | Two Piece Nick. Bonded TC Hard Face Material Under Compression | | | | | |
| ွေအ | Two Piece Nick. Bonded TC Hard Face Material Under Tension | | | | | |
| odwo | One Piece Rxn Bond SC Hard Face Material Under Compression | | | | | |
| nent | One Piece Thin Walled Rxn Bond SC Hard Face Material Under Tension | | | | | ! |
| | Two Piece Rxn Bond SC Hard Face Material Under Compression | | | | | - |
| | Two Piece Rxn Bond SC Hard Face Material Under Tension | | | | _ | |
| **** | One Piece Alpha SC Hard Face Material Under Compression | | | | | |
| | | | | | | |
| | One Piece Thin Walled Alpha SC Hard Face Material Under Tension | Yes | | | | |
| | Two Piece Alpha SC Hard Face Material Under Compression | | | | ! | : |
| | Two Piece Alpha SC Hard Face Material Under Tension | | | | | |
| | One Piece Chrome Oxide Hard Face Material Under Compression | | | | | |
| | One Piece Chrome Oxide Hard Face Material Under Tension | | | | | |
| <u></u> | Two Piece Chrome Oxide Hard Face Material Under Compression | | | | : | |
| - -L | Two Piece Chrome Oxide Hard Face Material Under Tension | | | | | |
| | Practice of replacing hard seal faces on cartridge and component seals. | | | | | |
| | Practice of reusing relapped hard seal faces on cartridge and component seals. | | | | | |
| - | | | | | | |
| | Practice of replacing seal faces with corrosion/pitting on cartridge and component seals. | | : | · · | | |
| <u></u> | Practice of reusing seal faces with corrosion/pitting on cartridge and component seals. | | | | | |
| | 0 | | | | | |

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GROUP 3600

Rotary
Face | Material | s of | Constru | ction

PATENT & TREE

| Ιø | . 1 . 60 | 1 | ιω | | 1- | ı v v | | | T | | | | -11 | _ | _ | , | _ | | 11 | | | | | | |
|--------------------|------------------------------|-----------------|--------------------------------------|------|------|-----------------------------------|----------------------------|--|-------------------|-------------------|----------|----------|----------------|--------------|----------|---|--------------|---------------|--|------------------|----------|--|--|-----------------|-----------|
| gger | If > | | Source | | | Cos | Cost | ≥ | | | | | | | | | | ! | | : | | - | | | 1 |
| ity tri | Prod | | in res | | | | Etc | | | | | | | | | | | : | | | i | | | | |
| Viscosity triggers | | | The increase or decrease in resource | | | | Disp | 25 | | | | | | | | | | : | | | : | | \prod | | |
| | | | decre | | | it, etc | aint | - | | | i | i | \parallel | T | | | | | $\dagger \dagger$ | | : | | $\dagger \dagger$ | | \dashv |
| | | | se or | | ÷ | Labor Cost, etc. | Speci Inst Oper Maint Disp | 5 | $\dagger \dagger$ | | _ | 1 | \parallel | + | \vdash | | + | 1 | # | - - | <u> </u> | <u>. </u> | ${\parallel}$ | | \dashv |
| | | | ncrea | | | Labo | nst O | ố ■ | + | | | | ╫╴ | + | \vdash | | + | | ${f H}$ | + | - | - | ╫ | ! | \dashv |
| | | | The | | | | eci " | <u>, </u> | H | | | | ╫ | | | | \dagger | - | $\dagger \dagger$ | | + | | H | <u> </u> | \dashv |
| | | \vdash |] 8 | | _ | سد | ගි ≥ | + | + | | | _ | # | - | _ | | - | | \parallel | 1 | | <u> </u> | $\!$ | | \dashv |
| | | se or | decrease in resource | i | | Estimated Product Life In Days | ي يا پر يا | 3 | | | | | | | | | | | | | | | | | |
| | | crea | ë | life | MTBF | imated Prod Life In Days | Best in | | \sqcup | | | | ╢_ | | | | \downarrow | - | \prod | | | | \coprod | | \dashv |
| | | The increase or | rease | | 2 | stimal Life | Est. Life | | | | | | | | | | | | | | | | | | |
| | <u> </u> | | ළ | ı | | ш — | Est | _ - | | | | <u> </u> | ╢ | _ | | | \downarrow | | \prod | _ | | <u> </u> | \coprod | <u> </u> | \dashv |
| | re Gra | 1 | ⋖ | | | | | | \square | _ | - | | ╫ | ╀ | | | + | | \prod | 1 | | <u> </u> | \coprod | | \dashv |
| S 75 | = | | ⋖ | _ | | | | + | H | | | - | ╫ | ╀ | | | ╀ | <u> </u> | $\!$ | + | - | 1 | ╫ | | \dashv |
| Elastomers | <u> </u> | + | ∀ | | | | | + | + | 1 | : | | ╫ | - | | | ╁ | <u> </u> | ╫ | 1 | | $\frac{\perp}{1}$ | ╫ | + | \dashv |
| Elast | Tefl At | | A | | | | | | H | - | + | - | \parallel | ╁╴ | | | ╁ | | ╫ | + | | 1 | ╫ | | \dashv |
| | g: « | | A | | | | | | \Box | 1 | | - | | 1 | | | ╁ | | \parallel | | | - | $\dagger \dagger$ | : | + |
| | Vito | | z | | | | | | \prod | | | i | | | | | | | \parallel | İ | | Ì | \parallel | | \forall |
| | Chrome | | | | | | | | | | | | | | | | | | | | | | | | |
| 74 | | \top | _ | | | | | | | $\frac{\cdot}{1}$ | \dashv | 1 | ╟ | \vdash | | | \dagger | 1 | \parallel | + | 1 | - | H | + | + |
| ΙÜ | Plate Cera d TC mic | + | A | | | : | | + | \Box | | - ! | 1 | \parallel | | | | \dagger | <u> </u> | \parallel | | - | | H | | + |
| Faces | Nickel Bonde d TC | | | | | | | + | $ \cdot $ | | | - | \parallel | | | | t | - | \parallel | | 1 | - | $\parallel \parallel$ | | \dashv |
| ŀ | i g | + | ۷ | | | | | + | H | - ! | + | 1 | \parallel | \vdash | Н | _ | igdash | <u> </u> | \parallel | | - | 1 | $\!$ | | \perp |
| | Bond ed | 3 | ٧ | | | | | _ | \sqcup | | | \bot | \parallel | | - | _ | lacksquare | 1 | | | | 1 | $\!$ | | \perp |
| | Alpha Sintere d SC | | ٧ | | | | | | | | | | | | | | | | | | | | | | |
| 75 | 1 0 | | ٧ | | | | | | П | | | | | | | | | | $\ $ | T | | | | T | \top |
| 7 | / Titan | | | | | | | | | | | | | Γ | | 7 | T | İ | | 6 | | | | | |
| lurgy | Hast | \prod | A | | | | | | П | İ | | T | | | | | | İ | \parallel | 1 | F | D | | IV | |
| Meta | Alloy 20 | | | | | | | 1 | \prod | | İ | | \parallel | | П | 1 | | | 1 | | | | |) 20 | 103 |
| Metalurgy | Alloy Hast Titan 20 C ium | | A A | | | | | | | | | | | | | | | | | 31 | F | | | 5 | √ 20 |

FIG. 7C

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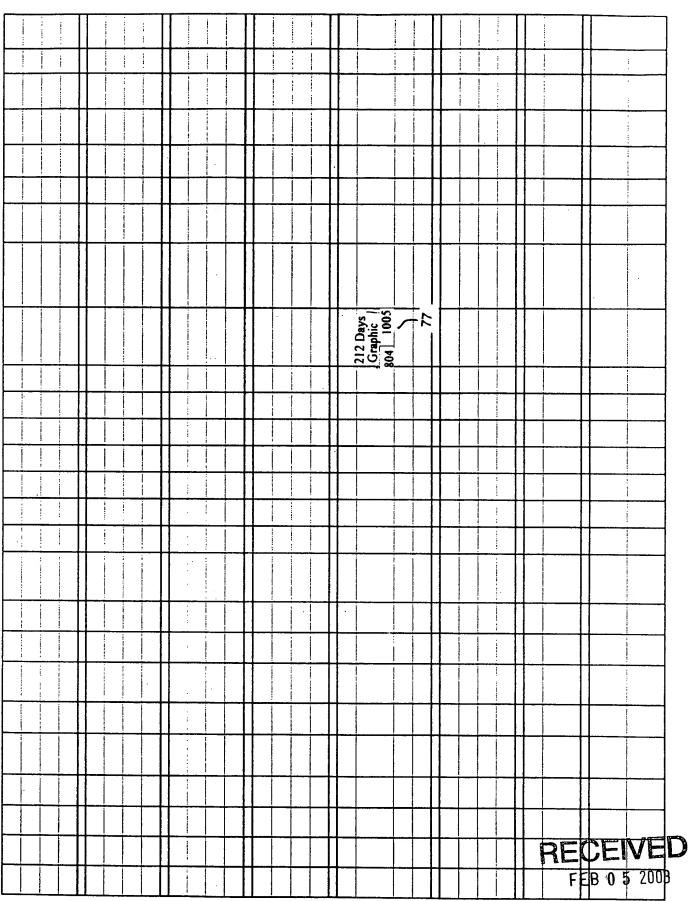


FIG. 7D

GROUP 3600

O STEELT & THE WAY

| <i>Jieros</i> | | | | | | | | | | <u>a </u> | Product |
|------------------|-------------------------|-----------------|---|---------|--|---------|------------|-------------------|-----------------------------------|---|-----------------------------|
| Š | s Viscosity > 15000 | | | | | | | | | ΪŞν | Has Viscosity < 15000 |
| | | | 15500 | | | | | | | - | |
| inc | reases or buying, us | decre ing, c | reases or decreases the H, M, O re buying, using, or selling a resource. | H, M, C | · life increases or decreases the H, M, O resource costs as a result of all decisions when buying, using, or selling a resource. | resu | t of all (| decis | ions whe | | |
| ž | | | | | .0. | | | | | + | |
| t of M ources | Cost of Item | Item | | | Utilities | | Safety | | Environment al | eut | |
| Etc. | Cost of Item | 왕 . | Etc Energy/ . Electirc | Wate | Wate Sewage r | Etc . | Safet E | a E | Etc Safet Etc Environ y mental | . Etc | |
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| | | | | | | \prod | | $\dagger \dagger$ | | ╫ | |
| | R | | | | | | | | | | |
| F | E | | | | | | | \parallel | | - | |
| В | C | | | | | | | | | | |
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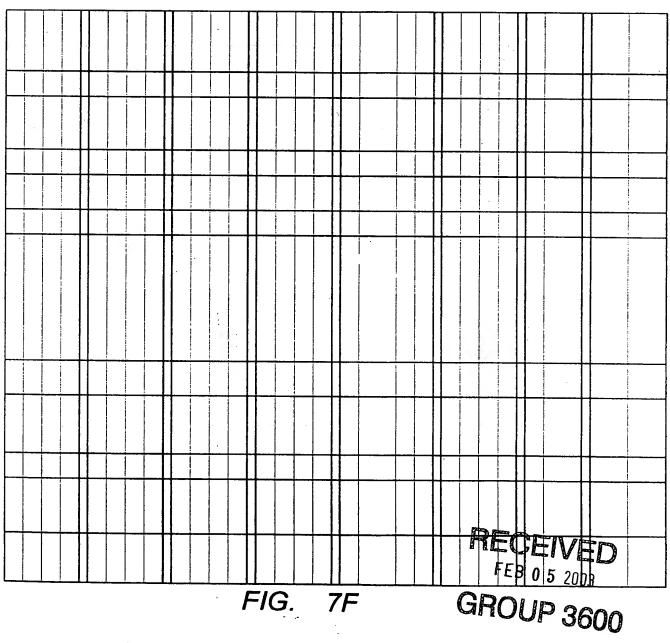


FIG. 7F

| | Seal: | xxxxxxxxx ~ | - 80 |
|--------|----------------------|--------------------|-------------|
| | | | |
| | | | |
| | | Product/Service | ~82 |
| | | Skill Level Rating | - 02 |
| | | Required | |
| | Specify | 7.5 | |
| | Purchase | 5 | |
| | Install with generic | | |
| | installation | 10 | |
| | instructions | | |
| | Install with | | |
| | engineered | 5 | |
| | installation | | |
| Seal | instructions | | |
| Itself | Operate with generic | | |
| | operating | 5 | |
| | instructions | й <u>—</u> . | |
| | Operate with | | |
| | engineered | 2.5 | |
| | operating | 2.9 | |
| 1 | instructions | | |
| | Disposal | 2.5 | |
| | Sell | 2.5 | |
| Repair | Specify | 2.5 | |
| / | Purchase | 2.5 | |
| Rebuil | Repair | 7.5 | |
| d of | Disposal | 5 | l |
| Seal | Sell | 2.5 | |
| | Specify | 7.5 | |
| | Purchase | 2.5 | |
| | Install with generic | * | |
| | installation | 7.5 | |
| | instructions | | |
| | Install with | | |
| | engineered | 2.5 | |
| API | installation | 2.0 | • |
| Plans | instructions | | |
| for | Operate with generic | , | |
| Seal | operating | 5 | |
| | instructions | |] |
| | Operate with | | |
| 1 | engineered | 2.5 | |
| | operating | 2.5 | |
| | instructions | | |
| | Disposal | 7.5 |] |
| | Sell | 2.5 | |

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FIG. 8



| | 3196 (Pump) |
|---|----------------------------|
| ; | |
| | Seal fits with no |
| AV3000175A (Seal) | modifications |
| | Seal fits with no |
| AV3200175EA (Seal) | modifications |
| | |
| | |
| | Special gland |
| XXXXX 5610 | modifications required |
| | |
| | Special sleeve |
| XXXXX Type 9 | modificatins required |
| | |
| XXXXX 155 | |
| XXXXX 123 | |
| , | |
| · · · · · · · · · · · · · · · · · · · | |
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| 1 | |
| | XXXXX 5610 XXXXX Type 9 |

These results come from the CA & SS from ESP

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| | | T |
|------------|---|---------------------------------------|
| | | Process Fluid |
| | • • | Acetone; Tem <210 F |
| | : | System Recommendations |
| | | |
| Recom | | |
| mended | • | |
| Seal | · | Double |
| Туре | Double | |
| | 316 SS | Α |
| Motolus | Alloy 20 | A |
| • | Hast C | Ä |
| ду | Titanium | \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ |
| | Carbon | A |
| <u> </u> | Alpha Sintered SC | T A |
| <u> </u> | Rxn. Bonded SC | A |
| ——— | Nickel Bonded TC | A |
| | Plated TC | N |
| Faces | Ceramic | A |
| | Chrome Oxide | N |
| | Viton | N N |
| | EPR | A |
| | Teflon | A |
| Elastom | Aflas | N |
| ers | Kalrez | A |
| | Chemraz | Α |
| | Graphoil | A |
| | C31- Mfg. Recommends The Use of A | |
| | Model that supports an option two piece | No |
| | stationary head | |
| | Pumping Feature Required | Yes |
| | Quench & Drain Required | No |
| | | |

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| 3 2003 | E | | - 1/ - 1/ - 1/ - 1/ - 1/ - 1/ - 1/ - 1/ | | | | |
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| ENT & TH | | | <u> </u> | | | 1100- | |
| | | | Analyze Constraints | Work Force Average Sk | | 5 | |
| | | | | lindividual Skiil Level - F | John Mary | 7 3 | |
| | | | Gather Information To Make | Work Force Average Sk | ill Level | 5 | |
| | | | Purchasing Decision | Individual Skill Level | John Mary | 7 3 | |
| | | | Assess Information | Work Force Average Sk | | 5 | |
| | | | , 100000 milemanen | | John | 7 | |
| | | | · | Undividual Skill Level - F | Mary | 3 | |
| | | | Perform Analysis | Work Force Average Sk | | 5 | |
| | | | | | John | 7 | |
| | | | | Individual Skill Level | Mary | 3 | |
| | | | Decide on Repair/ Rebuild of | Work Force Average Sk | ill Level | 5 | |
| | | | product or service | Hindividual 2kili Level - F | John | 7 | |
| | | | | | Mary | 3 | |
| | | | Assess Safety Impact | Work Force Average Sk | | 5 | |
| | | | | Hindividual Skill Level - F | John | 7 | |
| | | | 0.65 | 14/- 1 5 01 | Mary | 3 | |
| | | | Decide Safety Requirements | Work Force Average S | John | 5 | |
| | | Specify | | Hndividual Skill Level - F | Mary | 3 | |
| | | | Assess Environmental Impact | Work Force Average Sk | | 5 | |
| | | | | | John | 7 | |
| | | | | Individual Skill Level | Магу | 3 | |
| | | | Decide Environmental | Work Force Average Sk | ill Level | 5 | |
| RECE | VEL | | Requirements | Individual Skill Level | John | 7 | |
| FEB 0 5 | 2003 | ļ | | | Mary | 3 | |
| | 1000 | | Assess QC Requirements | Work Force Average Sk | _ | 5 | |
| GROU | 7 300 | J | · | Individual Skill Level | John | 7 | |
| | | | | Decide QC Requirements | Work Force Average S | Mary | 3 5 |
| | | | Decide QC Requirements | | John | 7 | |
| | | | | Individual Skill Level | Mary | 3 | |
| | Skill | | Assess Mfgs. Capabilities | Work Force Average Sk | | 5 | |
| | Level | | 3 | | John | 7 | |
| | Availab | | · | Individual Skill Level | Mary | 3 | |
| | le | | Decide on Mfg. | Work Force Average Sk | ill Level | 5 | |
| | | | | Individual Skill Level | John | 7 | |
| | | | | marviadar okin Lever | Mary | 3 | |
| | | | Decide on Specifications | Work Force Average Sk | | 5 | |
| | ļ | | | Individual Skill Level | John | 7 | |
| | | | Decide and Propers DEC | | Mary | 3 | |
| | l | 1 | Decide and Prepare RFQ | Work Force Average Sk | | 7 | |
| | | .11A | | Individual Skill Level | Bill Ed | 10 | |
| | ı iG. | • | Receive RFQ Responses and | Work Force Average Sk | | 7 | |
| | 1 | Purcha | Analyze | | Bill | 10 | |
| | | se | | Individual Skill Level | Ed | 4 | |
| | 1 | 1 1 | | | | | |

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| | Make Decision To Buy Product Work Force Average Skill Level | | | |
|----------|---|--------------------------------|-----------|--------|
| | , | Individual Skill Level | Bill | 10 |
| | | Individual Skill Level | Ed | 4 |
| | Assess equipment condition | Work Force Average Sk | ill Level | 6 |
| | ; | Individual Skill Level | Jim | 9 |
| Install | · | marviadar Okin Level | Ray | 3 |
| IIIstaii | Install Product | Work Force Average Sk | ill Level | 6 |
| | | Individual Skill Level | Jim | 9 |
| | | marviddar Okiii Eever | Ray | 3 8 |
| | Startup of Equipment | Work Force Average Skill Level | | |
| | , | Individual Skill Level | Mike | 10 |
| Operati | | <u> </u> | Jeff | 6 8 |
| on | Operation of Equipment | Work Force Average Skill Level | | |
| | | Individual Skill Level | Mike | 10 |
| | <u>:</u> | marvidaa. Okiii Eevei | Jeff | 6 |
| Dispos | Disposal of Equipment | Work Force Average Sk | ill Level | 4 |
| al | | Individual Skill Level | Wayne | 6 |
| | | maividdai Okiii Eever | Terry | 2 |
| | Decide on Sale | Work Force Average Sk | ill Level | 4 |
| Sell | : | Individual Skill Level Sue | | 3 |
| | | Individual Skill Level | Lori | 5 |

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23/47 T-9:9t:9 Seal Attributes Single Single Design Double Design Cartridge Cartridge Design Component Design Stationary Design Rotary Design Yes **Balanced Design Unbalanced Design** Yes Tandem Design Back to Back Design Internally Mounted Design Cartrid Gener **Externally Mounted design** Yes ge & al Comp Large Clearance Design Design onent Tight Clearance Designs Yes 1200 Double seal with pumping ring design Yes Double seal without pumping ring design High Balance Ratio Low Balance Ratio Yes Spring Loaded Design Metal Bellows Design Light Spring Load Per Square Inch High Spring Load Per Square Inch FEB 0 5 2003 Wide Face Width Narrow Face Width Single Seal with Large Dual Tangential Flush Holes Cartrid ge & Yes Single Seal with Small Straight Drill Holes Or No Flush Holes Design Comp onent Double seal with two flush holes on same surface Double seal with two flush holes 180 degrees apart Cartrid 316SS Metallurgy Yes Materi 1204 ge & Alloy 20 Metallurgy als of constr Comp Hastelloy C Metallurgy onent Titanium Metallurgy uction Cartrid Practice of using OEM certified glands in repair/rebuild ge & Comp onent | Practice of not using OEM certified glands in repair/rebuild Practice of replacing glands on cartridge seals with pitted surfaces FIG. 12A

FEB O TRADER

| , . | | 1 | | |
|--------|-----------------------|-----------|---|-----|
| | | | Practice of reusing glands on cartridge seals with pitted surfaces | |
| | | | Practice of replacing gland on cartridge seals with damaged (elongated) spring holes | |
| | | Cartrid | Practice of reusing gland on cartridge seals with damaged (elongated) spring holes | |
| Glands | | ge | Practice of replacing cartridge seals with worn anti-rotation lugs, pins, tabs, (tangs) in gland | - |
| | | | Practice of reusing cartridge seals with worn anti-rotation lugs, pins, tabs, (tangs) in gland | |
| | Repair & Rebuil | . !! | Practice of replacing cartridge seals with missing anti-rotation lugs, pins, tabs, (tangs) in gland | |
| | ding Proce | | Practice of reusing cartridge seals with missing anti-rotation lugs, pins, tabs, (tangs) in gland | |
| | dures ر | | Practice of replacing glands on component seals with pitted surfaces | |
| | 1202 | | Practice of reusing glands on component seals with pitted surfaces | |
| | | | Practice of replacing gland on component seals with damaged (elongated) spring holes | |
| | | Component | Practice of reusing gland on component seals with damaged (elongated) spring holes | |
| | | | Practice of replacing component seals with worn anti-rotation lugs, pins, tabs, (tangs) in gland | , |
| | | | Practice of reusing component seals with worn anti-rotation lugs, pins, tabs, (tangs) in gland | |
| | | | Practice of replacing component seals with missing anti-rotation lugs, pins, tabs, (tangs) in gland | |
| | | | Practice of reusing component seals with missing anti-rotation lugs, pins, tabs, (tangs) in gland | |
| | Materi | | 316SS Metallurgy RECEIVED | Yes |
| | als of constr | _ | Alloy 20 Metallurgy FEB 0 5 2003 | |
| | uction | onent | Titanium Metallurgy CDOI ID COO | |
| | | | Practice of using OEM certified sleeves in repair/rebuild | |
| | 9- | | Practice of not using OEM certified sleeves in repair/rebuild | |
| | | | Practice of replacing cartridge seals with worn drive lugs, pins, tabs, (tangs) in sleeve | |
| | | | Practice of reusing cartridge seals with worn drive lugs, pins, tabs, (tangs) in sleeve | |
| | | | Practice of replacing cartridge seals with missing drive lugs, pins, tabs, (tangs) in sleeve | |
| | | | Practice of reusing cartridge seals with missing drive lugs, pins, tabs, (tangs) in sleeve | |
| | ı | l I | | |

FIG. 12B

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| | | | Practice of replacing sleeves on cartridge seals with damaged (elongated) spring holes | |
|---------------------------------------|-------------------------|--------|---|---------------------------------------|
| | | 1 | Practice of reusing sleeves on cartridge seals with damaged (elongated) spring holes | |
| | | | Practice of replacing cartridge seals with worn drive lugs, pins, tabs, (tangs) on rotary unit set screwed to sleeve | |
| | | | Practice of reusing cartridge seals with worn drive lugs, pins, tabs, (tangs) on rotary unit set screwed to sleeve | |
| | | | Practice of replacing cartridge seals with missing drive lugs, pins, tabs, (tangs) on rotary unit set screwed to sleeve | |
| Sleeve | | | Practice of reusing cartridge seals with missing drive lugs, pins, tabs, (tangs) on rotary unit set screwed to sleeve | , |
| s or Barrel s | Repair & | | Practice of replacing sleeves on cartridge seals with pitted surfaces | |
| | Rebuil ding Proce | l I | Practice of reusing sleeves on cartridge seals with pitted surfaces | |
| | dures | | Practice of replacing damaged (fretted) sleeves on cartridge seals | |
| | | | Practice of reusing damaged (fretted) sleeves on cartridge seals | |
| | | | Practice of using OEM certified barrels in repair/rebuild | |
| · · · · · · · · · · · · · · · · · · · | | | Practice of not using OEM certified barrels in repair/rebuild | |
| | | | Practice of replacing component seals with worn drive lugs, pins, tabs, (tangs) in rotary unit | |
| | | | Practice of reusing component seals with worn drive lugs, pins, tabs, (tangs) in rotary unit | |
| · | | | Practice of replacing component seals with missing drive lugs, pins, tabs, (tangs) in rotary unit | · · · · · · · · · · · · · · · · · · · |
| - 10 | | | Practice of reusing component seals with missing drive lugs, pins, tabs, (tangs) in rotary unit | |
| RECEIV | ED | Comp | | |
| FEB 0 5 2 | | | Practice of reusing rotary units on component seals with damaged (elongated) spring holes | |
| GROUP | 360 | þ | Practice of replacing barrels on component seals with pitted surfaces | |
| | | | Practice of reusing barrels on component seals with pitted surfaces | |
| | | | Practice of replacing damaged (fretted) rotary sleeves or barrels on component seals. | |
| | | | Practice of reusing damaged (fretted) rotary sleeves or barrels | |
| | | | FIG. 12C | |

FEB O 3 2003 E

| | | Materi | Cartrid | 316SS Metallurgy | |
|-----|-------------------|------------------------|---------------|---|---|
| | | als of | ne & | Alloy 20 Metallurgy | |
| | - 1 | constr | | Hastelloy C Metallurgy | |
| | | uction | | | |
| | | uction | Onent | Titanium Metallurgy | |
| | | | ge a | Practice of using OEM certified face holders in repair/rebuild | |
| | | | Comp onent | Practice of not using OEM certified face holders in repair/rebuild | |
| | | | | Practice of replacing face holders on cartridge seals with pitted surfaces | |
| | Face | D | Cartrid | Practice of reusing face holders on cartridge seals with pitted surfaces | |
| | s | Repair & Rebuil | | Practice of replacing face holders on cartridge seals with worn drive/anti-rotation slots | |
| | | ding Proce dures | | Practice of reusing face holders on cartridge seals with worn drive/anti-rotation slots | |
| | | dules | | Practice of replacing face holders on component seals with pitted surfaces | |
| | | : | Comp | Practice of reusing face holders on component seals with pitted surfaces | |
| | · | | onent | Practice of replacing face holders on component seals with worn drive/anti-rotation slots | |
| | | | | Practice of reusing face holders on component seals with worn drive/anti-rotation slots | |
| | | Materi | Cartrid | 316SS Metallurgy | |
| | | als of | | Alloy 20 Metallurgy | |
| | | constr | | Hastelloy C Metallurgy | |
| | | uction | onent | Titanium Metallurgy | |
| | | | Onen | Trianium Metaliurgy | |
| | | | 3 | Practice of using OEM certified lock collars in repair/rebuild | |
| REC | | VEL | Comp | Practice of not using OEM certified lock collars in repair/rebuild | · |
| • | | 2003 | | Practice of replacing cartridge seals with damaged/oversized set screw holes on lock collars. | |
| GRO |)UF | 360 | 00 | Practice of reusing cartridge seals with damaged/oversized set screw holes on lock collars. | |
| | Lock | Pensir | | Practice of replacing cartridge seals with worn drive lugs, pins, tabs, (tangs) on lock collar | |
| C | Rebuil ding Proce | | Cartrid | Practice of reusing cartridge seals with worn drive lugs, pins, tabs, (tangs) on lock collar | |
| | | ding Proce dures | ge | Practice of replacing cartridge seals with missing drive lugs, pins, tabs, (tangs) on lock collar | |
| | | | | Practice of reusing cartridge seals with missing drive lugs, pins, tabs, (tangs) on lock collar | |
| | , | . | • | FIC 42D | |

FIG. 12D

| / ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ | | |
|---|--|----------|
| (FEB 0 3 5003 EE | 07/47 | |
| A CARLET | 27/47 | |
| TRADE | Practice of replacing lock collars on cartridge seals with pitted surfaces | |
| | Practice of reusing lock collars on cartridge seals with pitted surfaces | |
| Comp | Practice of replacing component seals with damaged/oversized set screw holes. | |
| · · | Practice of reusing component seals with damaged/oversized set screw holes. | |
| | Practice of using OEM certified faces in repair/rebuild | |
| | Practice of not using OEM certified faces in repair/rebuild | |
| | One Piece Carbon Soft Face Material Under Compression | |
| | One Piece Carbon Soft Face Material Under Tension | |
| | Two Piece Carbon Soft Face Material Under Compression | |
| | Two Piece Carbon Soft Face Material Under Tension | |
| | Practice of replacing soft seal faces on cartridge and component seals. | |
| | Practice of reusing relapped soft seal faces on cartridge and component seals. | |
| | | = |
| | One Piece Ceramic Hard Face Material Under Compression | |
| | One Piece Ceramic Hard Face Material Under Tension | |
| | Two Piece Ceramic Hard Face Material Under Compression | |
| | Two Piece Ceramic Hard Face Material Under Tension | |
| | One Piece Plated TC Hard Face Material Under Compression | |
| | One Piece Plated TC Hard Face Material Under Tension | |
| RECEIVED | Two Piece Plated TC Hard Face Material Under Compression | |
| FEB 0 5 2003 | Two Piece Plated TC Hard Face Material Under Tension | - |
| | One Piece Nick. Bonded TC Hard Face Material Under | |
| GROUP 3600 | Compression | |
| | One Piece Nick. Bonded TC Hard Face Material Under Tension | |
| Cartric | Two Piece Nick. Bonded TC Hard Face Material Under Compression | |
| I/B ge & Comp Station onent | Two Biggs Might Bonded TO Hard S. M. H. H. H. T. H. | |
| ary Face Materi | One Piece Rxn Bond SC Hard Face Material Under Compression | 目 |
| als of Constr | One Piece Rxn Bond SC Hard Face Material Under Tension | |
| uction | | \dashv |
| FIG. 12E | Two Piece Rxn Bond SC Hard Face Material Under Compression | |

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| | | Two Piece Rxn Bond SC Hard Face Material Under Tension | |
|---------------------------------|-----------|---|-------------|
| | | One Piece Alpha SC Hard Face Material Under Compression One Piece Alpha SC Hard Face Material Under Tension | |
| | | One Piece Alpha SC Hard Face Material Orider Terision | |
| | | Two Piece Alpha SC Hard Face Material Under Compression | |
| | | Two Piece Alpha SC Hard Face Material Under Tension | |
| | | One Piece Chrome Oxide Hard Face Material Under Compression | |
| | | One Piece Chrome Oxide Hard Face Material Under Tension | |
| | | Two Piece Chrome Oxide Hard Face Material Under Compression | |
| | | Two Piece Chrome Oxide Hard Face Material Under Tension | |
| | | Practice of replacing hard seal faces on cartridge and component seals. | |
| | | Practice of reusing relapped hard seal faces on cartridge and component seals. | |
| | | Practice of replacing seal faces with corrosion/pitting on cartridge and component seals. | |
| | | Practice of reusing seal faces with corrosion/pitting on cartridge and component seals. | |
| | | Practice of replacing rotary units with fretting corrosion visible on ID of faces | |
| | Component | Practice of reusing rotary units with fretting corrosion (common on rotary faces that use teflon v rings) visible on ID of faces (Most common on stainless steel chrome oxide plated faces) | |
| | <u> </u> | | |
| | | Practice of using OEM certified faces in repair/rebuild | |
| · | | Practice of not using OEM certified faces in repair/rebuild | |
| | | One Piece Carbon Soft Face Material Under Compression | |
| RECEIVE | | One Piece Carbon Soft Face Material Under Tension | |
| FEB 0 5 2002 | | Two Piece Carbon Soft Face Material Under Compression | |
| CDC 1 | | Two Piece Carbon Soft Face Material Under Tension | |
| RECEIVED FEB 0 5 2003 GROUP 360 | 00 | Practice of replacing soft seal faces on cartridge and component seals. | |
| | | Practice of reusing relapped soft seal faces on cartridge and component seals. | |
| | | | |
| FIG. | 125 | One Piece Ceramic Hard Face Material Under Compression | |
| rig. | 125 | One Piece Ceramic Hard Face Material Under Tension | |

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| (A) | ÈNT G | TRADEMART |

I/B Rotary Face Materi als of Constr uction

| | | | · |
|-----------|-----------------|---|---------------|
| | | T D: 0 : 11 15 May :-111-day 0 | |
| | | Two Piece Ceramic Hard Face Material Under Compression | |
| | | Two Piece Ceramic Hard Face Material Under Tension | |
| | | | |
| | | One Piece Plated TC Hard Face Material Under Compression | |
| | | One Piece Plated TC Hard Face Material Under Tension | |
| | | | |
| | | Two Piece Plated TC Hard Face Material Under Compression | |
| | | Two Piece Plated TC Hard Face Material Under Tension | |
| | | One Piece Nick. Bonded TC Hard Face Material Under | |
| | | Compression | |
| | | | |
| | · | One Piece Nick. Bonded TC Hard Face Material Under Tension | |
| | C | Two Piece Nick. Bonded TC Hard Face Material Under | |
| | Cartrid ge & | Compression | |
| 3 | Comp | | |
| ıry | onent | Two Piece Nick. Bonded TC Hard Face Material Under Tension | |
| е | | | |
| eri | | One Piece Rxn Bond SC Hard Face Material Under Compression | |
| of str | | | |
| วท | | One Piece Rxn Bond SC Hard Face Material Under Tension | |
| | | | |
| | | Two Piece Rxn Bond SC Hard Face Material Under Compression | |
| | | T D D D 10011 15 M 1 1 1 1 7 1 | |
| | | Two Piece Rxn Bond SC Hard Face Material Under Tension | |
| | | | |
| | | One Piece Alpha SC Hard Face Material Under Compression | |
| | | One Piece Alpha SC Hard Face Material Under Tension | Yes |
| | | | |
| | | Two Piece Alpha SC Hard Face Material Under Compression | |
| | | Two Piece Alpha SC Hard Face Material Under Tension | |
| | | One Piece Chrome Oxide Hard Face Material Under | |
| | | Compression | |
| | | | |
| | | One Piece Chrome Oxide Hard Face Material Under Tension | |
| | | Two Piece Chrome Oxide Hard Face Material Under | |
| | | Compression | |
| à | | Two Piece Chrome Oxide Hard Face Material Under Tension | |
| ij | · · | Two Flece Chrome Oxide Haid Face Material Onder Tension | |
| | | Practice of replacing hard seal faces on cartridge and | |
| | | component seals. | |
| | | Practice of reusing relapped hard seal faces on cartridge and | |
| | | component seals. | |
| | | Practice of replacing seal faces with corrosion/pitting on cartridg | |
| | | and component seals. | |
| | 120 | Practice of reusing seal faces with corrosion/pitting on cartridge | |
| 1 | 20 | and component seals. | |
| | - | | L |

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GROUP 3600

FIG.

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| 1 | · [| 1 | | Practice of replacing rotary units with fretting corrosion visible on | |
|------|-------|-----------------|---------------|--|---|
| | | | | ID of faces | |
| | | | Comp | Practice of reusing rotary units with fretting corrosion (common | |
| e. | | | Onone | on rotary faces that use teflon v rings) visible on ID of faces | |
| | | | | (Most common on stainless steel chrome oxide plated faces) | |
| | | | | Soft Face Combination Carbon/Carbon | |
| | | | Cartrid | Soft Face Combination Carbon/Ceramic Soft Face Combination Carbon/Plated TC | |
| | | _ | ge & | Soft Face Combination Carbon/Plated TC Soft Face Combination Carbon/Nick. Bonded TC | |
| | | I/B Faces | Comp onent | Soft Face Combination Carbon/Rxn Bond SC | |
| | | ln | | Soft Face Combination Carbon/Alpha SC | |
| · | | Combi nation | | Soft Face Combination Carbon/Chrome Oxide | |
| | | | | Hard Face Combination SC/SC Hard Face Combination SC/TC | |
| | | | _ | Hard Face Combination TC/TC | |
| | _ | | | Hard Face Combination Cer/Cer | |
| | Faces | | <u> </u> | Practice of using OEM certified faces in repair/rebuild | |
| | | | | Practice of not using OEM certified faces in repair/rebuild | |
| | | | | - radio de marca de la companya de l | |
| | | | | Con Binar Code Safe Fore Made della des Communica | |
| | | | | One Piece Carbon Soft Face Material Under Compression One Piece Carbon Soft Face Material Under Tension | * |
| | | | | | |
| | 2.5 | | | Two Piece Carbon Soft Face Material Under Compression | |
| | | | | Two Piece Carbon Soft Face Material Under Tension | |
| . : | | | | Practice of replacing soft seal faces on cartridge and component seals. | |
| | | | | Practice of reusing relapped soft seal faces on cartridge and | |
| | | | | component seals. | 6 |
| | | | | One Piece Ceramic Hard Face Material Under Compression | |
| | | | | One Piece Ceramic Hard Face Material Under Tension | |
| | | | | T. B | |
| | | | | Two Piece Ceramic Hard Face Material Under Compression Two Piece Ceramic Hard Face Material Under Tension | |
| | • | | | | |
| RE | CFI | VE | - | One Piece Plated TC Hard Face Material Under Compression | |
| RE | Bnr | 2000 | | One Piece Plated TC Hard Face Material Under Tension | |
| GRO | _ 0 0 | 2003 | | Total Biolog Block of TO March Fores March State (1997) | |
| JHC) | YUP | 360 | n | Two Piece Plated TC Hard Face Material Under Compression Two Piece Plated TC Hard Face Material Under Tension | |
| | | | | | |
| | | | | One Piece Nick. Bonded TC Hard Face Material Under Compression | |
| | | 1 | 1011 | | |
| | FIG | i. ' | 12H | One Piece Nick. Bonded TC Hard Face Material Under Tension | |

| | | | | 1 | | | | | | |
|------|------|----------------|-----------|---|---|--|--|--|--|--|
| 1 | - 1 | J | | Two Piece Nick. Bonded TC Hard Face Material Under | | | | | | |
| | İ | Ì | Cartrid | | 1 | | | | | |
| | } | | ge & | | | | | | | |
| 1 | | O/B Station | Comp | Two Piece Nick. Bonded TC Hard Face Material Under Tension | | | | | | |
| | | | onent | 1 WO F ICCC 14ICK. DOTIGED TO FIGURE 1 ace Material Officer Tellision | | | | | | |
| | | ary Face | | : | | | | | | |
| | | Materi | | One Piece Rxn Bond SC Hard Face Material Under Compression | | | | | | |
| | Ì | als of | | | | | | | | |
| | | Constr | | One Piece Rxn Bond SC Hard Face Material Under Tension | 1 | | | | | |
| İ | | uction | | One Fiele Rail Bond So haid Face Material Onder Tension | | | | | | |
| | | uction | | | | | | | | |
| | | | | Two Piece Rxn Bond SC Hard Face Material Under Compression | | | | | | |
| | | | | | | | | | | |
| | | | | Two Piece Rxn Bond SC Hard Face Material Under Tension | | | | | | |
| | | | | | | | | | | |
| | | | | | ĺ | | | | | |
| | | | | One Piece Alpha SC Hard Face Material Under Compression | | | | | | |
| | | | | One Piece Alpha SC Hard Face Material Under Tension | | | | | | |
| | | | | | | | | | | |
| | | | | Two Piece Alpha SC Hard Face Material Under Compression | | | | | | |
| | | | | Two Piece Alpha SC Hard Face Material Under Tension | | | | | | |
| - | | - | | | | | | | | |
| | | | | One Piece Chrome Oxide Hard Face Material Under | | | | | | |
| | | | | Compression | | | | | | |
| | | | | | | | | | | |
| | | | | One Piece Chrome Oxide Hard Face Material Under Tension | | | | | | |
| | | | | Two Piece Chrome Oxide Hard Face Material Under | | | | | | |
| | | | | Compression | | | | | | |
| | | | | | | | | | | |
| | | | | Two Piece Chrome Oxide Hard Face Material Under Tension | | | | | | |
| | | | | TWO 7 1000 OTHER DAIGO HAIGH A GOO MALCHAI CHIGGI TOHIOCH | | | | | | |
| R | EB 0 | 3 | <u> </u> | Practice of replacing hard seal faces on cartridge and | | | | | | |
| - 48 | | :/VE | | component seals. | | | | | | |
| A | ER a | - | | Practice of reusing relapped hard seal faces on cartridge and | | | | | | |
| 0- | 10 0 | P 2003 | | component seals. | | | | | | |
| GR | | a _ | | | | | | | | |
| 24 | JUL | 361 | 70 | Practice of replacing seal faces with corrosion/pitting on cartridge | | | | | | |
| | | 406 | YU | and component seals. | | | | | | |
| | | | | Practice of reusing seal faces with corrosion/pitting on cartridge | | | | | | |
| | | | | and component seals. | | | | | | |
| | | | | Proctice of replacing reteriority with feeting assessment visits | | | | | | |
| | | | 1 | Practice of replacing rotary units with fretting corrosion visible on | | | | | | |
| | | | | ID of faces | | | | | | |
| | | | Comp | Practice of reusing rotary units with fretting corrosion (common | ļ | | | | | |
| | | | onent | on rotary faces that use teflon v rings) visible on ID of faces | | | | | | |
| | | | | · · · · · · · · · · · · · · · · · · · | | | | | | |
| | | | | (Most common on stainless steel chrome oxide plated faces) | | | | | | |
| | | | T | | | | | | | |
| | | | | Practice of using OEM certified faces in repair/rebuild | | | | | | |
| | | | 1 | Practice of not using OEM certified faces in repair/rebuild | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | One Piece Carbon Soft Face Material Under Compression | | | | | | |
| | FIG | <u>`</u> | 121 | One Piece Carbon Soft Face Material Under Compression | | | | | | |
| | 1 10 | <i>.</i> | 121 | One Piece Carbon Soft Face Material Under Tension | | | | | | |
| | | | | | | | | | | |

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| | | | Two Piece Carbon Soft Face Material Under Compression | |
|------------|----------------|---------|---|------|
| | | | Two Piece Carbon Soft Face Material Under Tension | |
| | | | Practice of replacing soft seal faces on cartridge and component seals. | |
| | | | Practice of reusing relapped soft seal faces on cartridge and | |
| | | | component seals. | |
| | | | | |
| | | | One Piece Ceramic Hard Face Material Under Compression | |
| | | | One Piece Ceramic Hard Face Material Under Tension | |
| | | | | |
| | | | Two Piece Ceramic Hard Face Material Under Compression | |
| | | | Two Piece Ceramic Hard Face Material Under Tension | |
| | | | · | |
| | | | One Piece Plated TC Hard Face Material Under Compression | |
| | | | One Piece Plated TC Hard Face Material Under Tension | |
| | | | Two Piece Plated TC Hard Face Material Under Compression | |
| | | | Two Piece Plated TC Hard Face Material Under Tension | |
| | | | | |
| | | | One Piece Nick. Bonded TC Hard Face Material Under Compression | |
| | | | Odmpicasion | |
| | | | One Piece Nick. Bonded TC Hard Face Material Under Tension | |
| | | Cartrid | Two Piece Nick. Bonded TC Hard Face Material Under | |
| | | ge & | Compression | |
| | O/B | Comp | Two Diago Nick Bondod TC Hard Eago Motorial Under Tancian 1 | |
| | Rotary | onent | Two riece Nick. Bonded To Hard race Material Order Fension | |
| | Face Materi | | One Bines Byn Bend SC Herd Fore Meterial Hader Compression | |
| | als of | | One Piece Rxn Bond SC Hard Face Material Under Compression | |
| | Construction | | One Piece Rxn Bond SC Hard Face Material Under Tension | |
| | uction | | | ···- |
| | | | Two Piece Rxn Bond SC Hard Face Material Under Compression | |
| | | | Tive Biose Byn Bond CC Head Fore Metaiel Hedes Torsies | |
| Δ. | | | Two Piece Rxn Bond SC Hard Face Material Under Tension | |
| 78 | | | | |
| - 150 | PIN . | | One Piece Alpha SC Hard Face Material Under Compression One Piece Alpha SC Hard Face Material Under Tension | |
| Go Co | 9 | | One Fiece Alpha SC Hard Face Material Origer Tension | |
| | 200 | | Two Piece Alpha SC Hard Face Material Under Compression | |
| | 3 | | Two Piece Alpha SC Hard Face Material Under Tension | |
| | 460, | | One Piece Chrome Oxide Hard Face Material Under | |
| GAOUR STEE | ~ | | Compression | |
| | | | | |
| | | 1 | One Piece Chrome Oxide Hard Face Material Under Tension | _ |
| FIG | i. 1 | 12J | Two Piece Chrome Oxide Hard Face Material Under Compression | |
| • | | | Compression | |

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| | | | | γ |
|-------|------------------|----------------------------------|---|-----------------|
| | | | Two Piece Chrome Oxide Hard Face Material Under Tension | |
| | | | Practice of replacing hard seal faces on cartridge and component seals. | |
| | | | Practice of reusing relapped hard seal faces on cartridge and component seals. | |
| | | | Practice of replacing seal faces with corrosion/pitting on cartridge and component seals. | |
| | ·• | | Practice of reusing seal faces with corrosion/pitting on cartridge and component seals. | |
| | | | Practice of replacing rotary units with fretting corrosion visible on ID of faces | |
| | | Comp onent | Practice of reusing rotary units with fretting corrosion (common on rotary faces that use teflon v rings) visible on ID of faces (Most common on stainless steel chrome oxide plated faces) | |
| | | | Soft Face Combination Carbon/Carbon | |
| | | | Soft Face Combination Carbon/Ceramic | |
| | О/В | ge & | Soft Face Combination Carbon/Plated TC | |
| | | | Soft Face Combination Carbon/Nick. Bonded TC Soft Face Combination Carbon/Rxn Bond SC | |
| | Faces | | | ļ |
| | Combi | Comp | Soft Face Combination Carbon/Chrome Oxide | |
| | nation | onent | Hard Face Combination SC/SC | |
| | | | Hard Face Combination SC/TC | <u> </u> |
| | | | Hard Face Combination TC/TC | <u> </u> |
| | | | Hard Face Combination Cer/Cer | |
| | | Cartrid | O-ring Elastomer Type | |
| | I/B | | Teflon V-Ring Elastomer Type | Yes |
| | Design | Comp | Teflon Wedge-Ring Elastomer Type | |
| | | onent | Teflon U-Cup Elastomer Type | |
| | | | Viton Elastomer Material | |
| | I/B | Cartrid ge & Comp onent | EPR Elastomer Material | |
| | Materi | | Teflon Elastomer Material | |
| | als of Constr | | IV-alson Florida man Makasial | <u> </u> |
| | uction | | Kalrez Elastomer Material Chemraz Elastomer Material | |
| | | | Graphoil Elastomer Material | 71 |
| | | Cartrid | O-ring Elastomer Type | |
| : | O/B | | Teflon V-Ring Elastomer Type | () ₂ |
| lasto | Design | Comp | Teflon Wedge-Ring Elastomer Type | ľ |
| mers | | onent | Teflon U-Cup Elastomer Type | 1 |
| | | | Viton Elastomer Material | |
| | O/B | Carrie | Teflon Elastomer Material FIG. 12K | |
| | | | 17-8- CL 4 44 1 1 CH 7 1/7 | 1 |
| | Materi als of | ge & | Teflon Elastomer Material Aflas Elastomer Material | |

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| RAPA | | | | |
|-----------------------|--------------------------------------|-----------------|--|-------|
| DEMARKS | Constr | onent | Kalrez Elastomer Material | |
| | uction | | Chemraz Elastomer Material | |
| | | | Graphoil Elastomer Material | |
| | Repair & | Cartrid | Practice of using OEM certified elastomers in repair/rebuild | |
| | Rebuil ding | ge & Comp | Practice of not using OEM certified elastomers in repair/rebuild | |
| | Proce dures | onent | Practice of replacing elastomers Practice of reusing elastomers | |
| | Design | | Spring Type (Wave Spring) Spring Type (Single Coil) Spring Type (Multiple Coil) Metal Bellows Design Out of Fluid Design | Yes |
| , | | | Immersed in process fluid Design | Yes |
| Face Energi | Materi als of constr uction | ge & Comp | 316SS Metallurgy Alloy 20 Metallurgy Hastelloy C Metallurgy Titanium Metallurgy | |
| zing Mecha nism | Repair & Rebuil | Cartrid ge & | Practice of using OEM certified springs in repair/rebuild Practice of not using OEM certified springs in repair/rebuild Practice of using OEM certified metal bellows in repair/rebuild | |
| ` | ding Proce dures | Comp onent | Practice of not using OEM certified metal bellows in repair/rebuild Practice of replacing springs | |
| | | | Practice of reusing springs 1 | |
| | | | Practice of replacing metal bellows Practice of reusing metal bellows | |
| | Repair | | Practice of using OEM certified gaskets in repair/rebuild | |
| Gaske ts | & Rebuil ding Proce | Comp | Practice of not using OEM certified gaskets in repair/rebuild Practice of replacing gaskets | |
| | dures | | Practice of reusing gaskets | |
| Seal Setting s | | | Stuffing Box Face Perpendicularity Chocker Cho | .003" |
| | | | | |

FIG. 12L

| | 7 1302 | ! | _ | | | _ | 7 38 38 | | | | | | <u> </u> |
|---------------|---------------------|------------------------|---------------------|---------------------|---------------------|------------------------------|------------------|----------------|-----------|---------------|--------------------|----------------------------------|------------------------------|
| Process Fluid | Acetone; Tem <210 F | System Recommendations | 150 F | Yes | Yes | No | 1.1 | 45 PSIA | 15000 SSU | 75% | 1% | 0.50% | 2% |
| | | | Product Temperature | Product Crystalizes | Product Polymerizes | Product is Thermal Sensitive | Specific Gravity | Vapor Pressure | Viscosity | Concentration | % Dissolved Solids | % Undissolved Non-Fibrous Solids | % Undissolved Fibrous Solids |

CROUP STORY



| # of days/year plant operates | |
|--|-------------|
| # of hours/day plant operates | |
| Kilowatts/hours for Avg. balanced seal | |
| Additional power required for unbalanced seal | |
| Average # of repacks per year | |
| Average # of adjustments per year per box | |
| Average Life of Shaft/Sleeve (in years) Before | |
| Replacement Is Required Due To Packing & Bearing | |
| Failure Damage | |
| Avg. Seal Water (in gpm) Flush Entering Each Packed | , |
| Stuffing Box , Entering the process stream | |
| Average Seal Water Flush (in gpm) required for a | |
| single mechanical seal entering the process stream. | |
| The Reduction in Seal Water Usage Per Stuffing Box | |
| By The Use Of Mechanical Seals | |
| Change In Temp. Difference Between System Temp. | |
| and Seal Water Flush Temp. (Ex. 85 Deg.F. system | |
| temp., 65Deg.F. Seal Water Temp = 20 Deg.F.) | |
| Avg. Requirement For A Packed Pump is 2KW Per | |
| Hour. Avg. For A Balanced Mechanical Seal Is .33KW | |
| Per Hour (The Excess Power Required Per Pump Is | |
| 1.67 KW/Hour) Based on 2.000 "seal, adjust up or | |
| down by average shaft/ sleeve size in plant | |
| Avg. Leakage of Each Stuffing Box in Drops/Min | |
| # of Machines With Unscheduled Downtime | |
| % of Equip. Requiring Unscheduled Repairs As a | |
| Result of Excess Leakage (Ex. Bearing failure due to | |
| product leakage contamination) | |
| Frequency of shaft /sleeve replacement | |
| % of Component Seals In Which Installation Is Not | |
| Correct The First Time | |
| Increased MTBF provided by superior seal design. | |
| Average Decrease In Seal Life For The Entire Plant | A. |
| Seal Population Due To Existing Design Deficiencies | |
| The spanding bas to Existing besign beholdholds | 0 20 |
| | |
| | "Of," s |
| · | CROUNS OF |
| FIG. 14A | ් ව |

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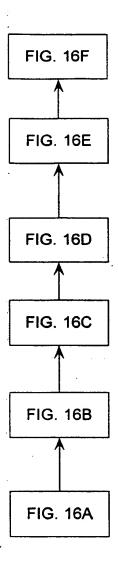


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| Overall | Increased MTBF provided by ESP software | · |
|--------------------------|---|---|
| Plant | technologies assuring that the correct seals with | |
| Informa | correct materials of construction and environmental | |
| tion | controls with engineering documentation provides | |
| | unsurpassed plant efficiencies. | |
| | · | |
| | Increased MTBF provided plant reliability software | |
| | which enables identification of problems preventing | |
| | reinstallation of those problems. | |
| | | |
| | Overall Decrease in Seal Life Due To Premature | |
| | Failure. (Over compressed & Under compressed | |
| | component and erroneous installations) | |
| | | |
| | | |
| | Additional Hours Req'd For Installation vs. Cartridge | |
| 1 | Design | |
| | Additional Hours Req'd For Component vs. Cartridge | |
| 1 | Design | |
| | Average Installation Time For A Component Seal | |
| Labor Informa tion | | |
| | Hours Required For Disassembly & Reinstallation of | |
| | Seal | |
| | Average # of Manhours Per Repack | |
| | Average # of Manhours Per Adjustment | |
| | Average # of Manhours Per Replacement | |
| | # of Hours Machinery Is Down Per Year Due to Eqpt | |
| | Failure Attributed to Product Leakage | |
| | # of Housekeeping / Hours Per Year Per Pump | |
| | (Cleaning Leakage) | |
| L | # of Hours To Install One Mechanical Seal | |

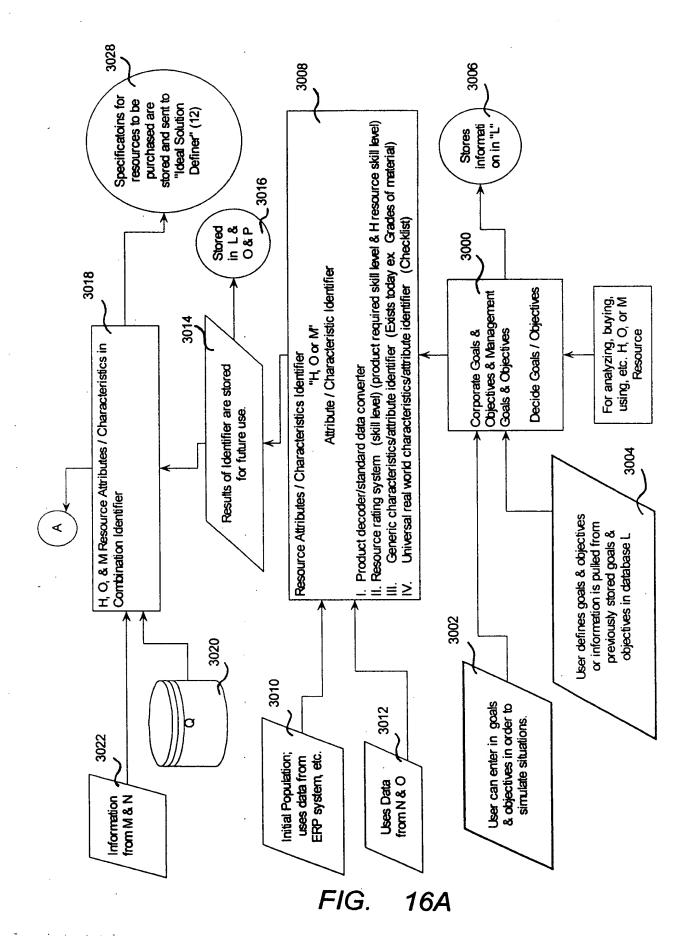
GROUP 3600



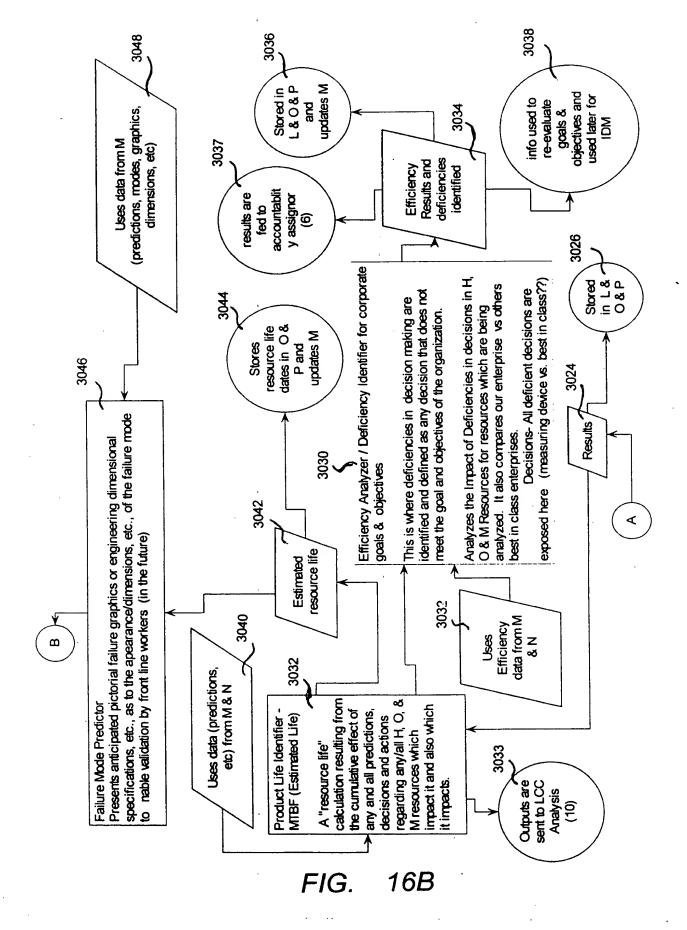


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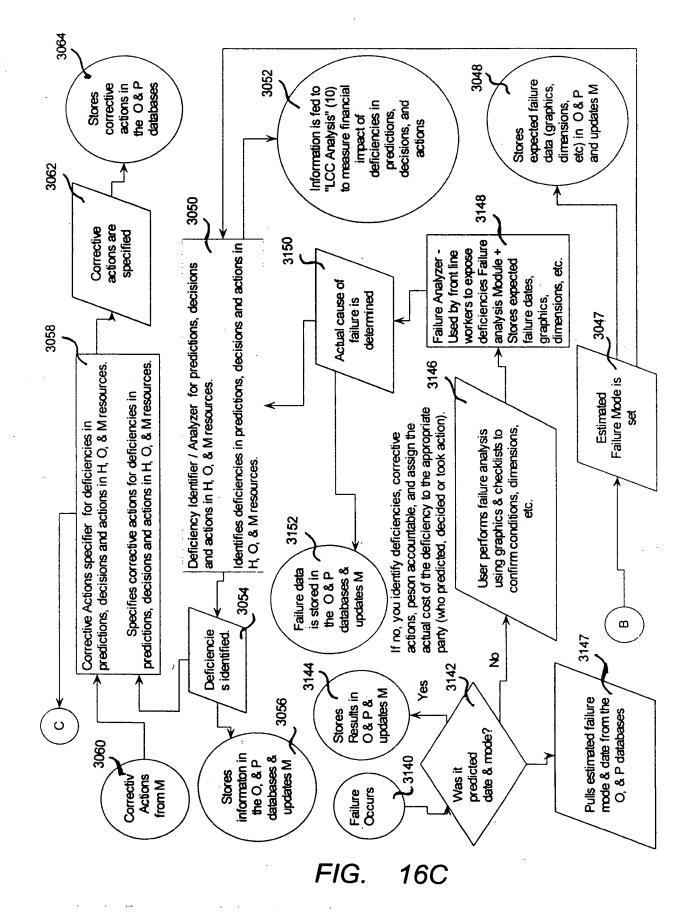
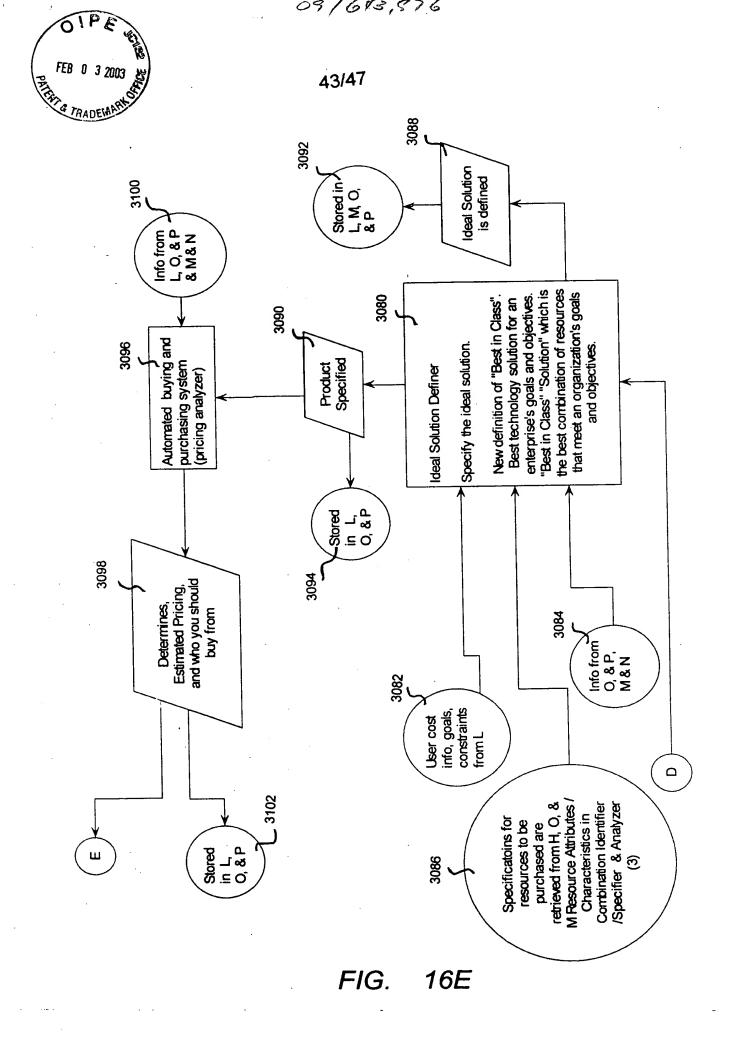
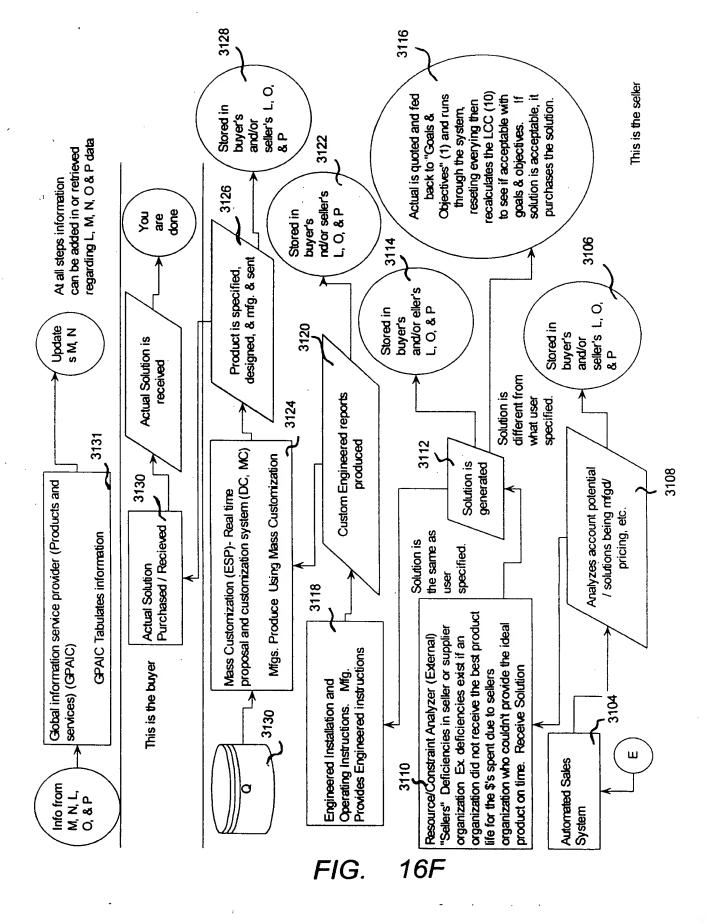


FIG. 16D





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₩. }

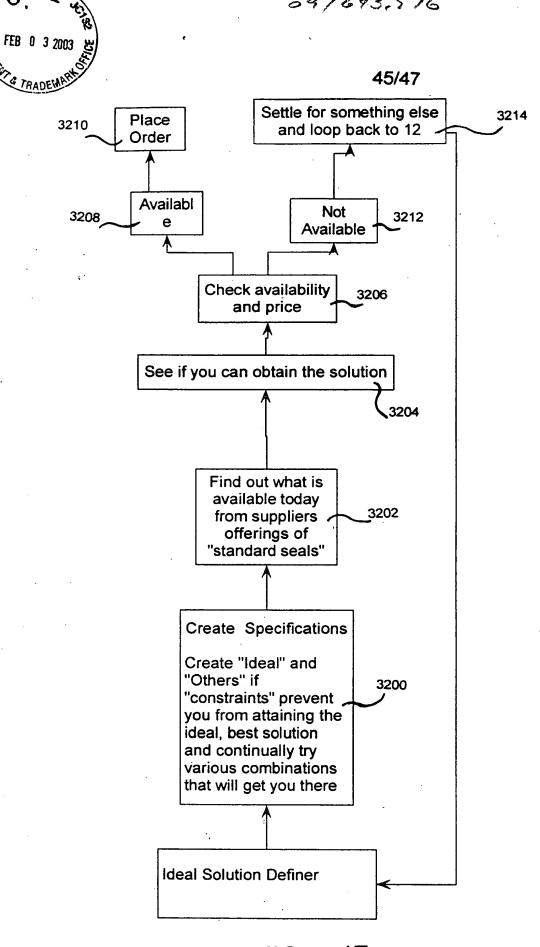


FIG. 17



| Laborations with migration and component of the followith selection and selections with a selection and selections with a selection and selections with a selection and selections with a selection and selection an | | Each test is | | 1800 Mfg. of | | · | - | 3 | 9 | Č | Supplier. | | Gland | Gasket | Spring |
|--|---------------------------------------|---|--------------------------|----------------------|---------------------|----------|----------------------|--------------------|----------------------|----------------|-------------------|--------------------|-----------------------|------------------|--------------------|
| borations with 1 Maje of net standard in a personnel bearing Maje of net similated life of the life and the laboratory wherein a rests stands entired in a laboratory conditions with Component of each in a laboratory conditions with Component individuals. A laboratory conditions with Component individuals with Component individuals experiment individuals. Laboratory conditions with Component individuals with Component individuals experiment individuals. Laboratory conditions with Component individuals experiment individuals experiment individuals experiment individuals. Laboratory conditions with Component individuals experiment individuals experiment individuals experiment individuals. Laboratory conditions with Component individuals experiment individuals experiment individuals experiment individuals. Laboratory conditions with Component individuals experiment individuals experiment individuals. Laboratory conditions with Component individuals experiment experiment individuals experiment experim | · | | | Component | | • | Ĭ | ace Supplie | <u></u> | 5 | puddoo fil | | s | S S | s S |
| Estimated life ory controlled aborative stands and 9% of life aboration | | controlled laboratory conditions with | Raw Materia I Mfos | Material | | ì | Material PG523 | Material PG792 | Material PG957 | Grade A | Grade B | Grade C | Etc. | Etc. | Etc. |
| Figurated life ory Estimated life ory Controlled life ory controlled life ory controlled life ory controlled life ory controlled life ory controlled life ory controlled life life ory controlled life life ory life ory life ory life ory life ory life ory life ory life ory life ory life ory life ory life ory life ory life ory life ory controlled life life ory life or each in a Laborat life ory life or each in a Laborat life ory life or each in a Laborat life ory life or each in a life or each in | | pre-selected expert | Perfor | | | | | | | | | | | | |
| Controlled any feat stands 1802 1808 18 | | Estimated life of each in a | Laborat ory Tests | Estimated | <u> </u> | | ate | Estimate d life | Estimated life | Estimated life | Estimated life | Estimat ed life | 12 years | & years | 20 years |
| 2 Each test is performed under controlled laborations with component expert individuals. Estimated life or ontrolled solution, 70 degrees, dust fee room, etc. Life 30 years 6 | | controlled environment | | 9 | | | | 15 years | | 1 year | 5 years | years | | | |
| 2 Each test is performed under controlled laborators with component Estimated life enronn, etc. Eximated fee room, etc. Controlled aborators with component Tests Estimated fee room, etc. Estimated fee room, etc. etc. Mtg. of Subassemb Bearing Mgs Protection Ntgs | | on test stands | | 7 | | | | | | | 1810 | | | | |
| 2 Each test is performed under controlled laboratory conditions with pre-select next in a controlled laboratory before the controlled laboratory of each in a controlled and selection and 6% oil solution. 70 degrees, dust feer room, etc., Life 30 years \$\int \text{Sign} \text{ Migs Protectio of each test is solution. 70 degrees and 6% oil selection. 4 laboratory of each time feer room, etc., Life 30 years \$\int \text{Sign} \text{ Firmated fife of life of life of life eroom, etc., } Estimated fife of life of | J | | | |] - | | 0001 | | | | | 1 | | | |
| under controlled laborators with Compo personned laborators with Compo pre-selected nent expert individuals. Estimated life and 6% oil solution, 70 degrees, dust fee room, etc., Life 30 years 45 years leaved a laborator controlled laborators with laborators with laborators and 6% oil each in expert and 6% oil each in a laboration, 70 degrees, dust fee room, etc., Life 30 years 45 years 6 years | L | | | Mfg. of Subassemb | Bearin | g Mfgs | Bearing Protectio | • | | Seal Mfgs | | 1 | Shaft | Impeller Mfgs | Human |
| Component Component Double ip seal Component Component Mfgs Component Mfgs Component Design with DL Vition with X filter System Caborat Estimated ed life and life | | performed under | | / | | | 20 | | | | | | #o40 | - | Criontic |
| Component Design with a DL Viton lube Design with a System System Estimated ed life ed life and life a | | controlled | | | Option 1 | | Double | | | | | * | with 3/04 of | | s / experts |
| Perfor Iube Design with x filter duromet system er, cory Tests Estimated ed life ed life ed life bears 6 yea | | conditions with pre-selected expert | Compo nent Mfgs | Design | | Option 2 | | Balance | d design 75 multi | 5/20 with fac | efc. | 00 with | 3 made of | Open impeller | |
| Life System er, toleranc e of .005 Estimated ed life ed life d life ed life ed life | | individuals. Estimated life | Perfor | | lube filter | Design | with x duromet | | | | j | | with | design | |
| Estimated ed life ed life d life 5 years 6 years 6 years 1812 | · · · · · · · · · · · · · · · · · · · | controlled environment Ex. Water | Laborat ony Tests | | system | | er' | | | | | | toleranc e of .005 | | ment, etc. etc. |
| Life ed life d life 5 years 50 years 50 years 1812 | | and 6% oil solution, 70 degrees, dust | | Estimated | Estimat | Estimat | Estimate | | Ш | stimated life | ω | | Estimate | | |
| 1812 — 1817 | | fee room, etc., etc., | | Life | ed line 30 years | | | | | 5 years | | _ | 50 years | 6 years | <u></u> |
| | | | | | | | + | | 1 | - 1812 - | | - | | | - |

FIG. 18A

| Γ | pe | | | | | П | | | | ø | | |
|-----------|--|--|---|---------------------------------------|---|---|------------------------------|---|--|--|--|--|
| | Pump Mfgs Controlled laboratory conditions of 70 degrees, same trained | | Seal mfg Life from above | 5 years | 1814 Estimated life could have been 12 years but now it is 3 years due to less than best in class offerings | | | | | Estimated life could have been 3 years but now it is 195 days due to less than best in class offerings | | |
| | ratory conditi | nents, etc. | Design with axial shaft play .006010 | 5 years | ears due to le | | Il World) | | | days due to le | | |
| | Pump Mfgs ontrolled labo | expert installs all components, etc. | Design with axial shaft play < .006 | 10 years | now it is 3 y | | End User Plants (Real World) | | | now it is 195 | | |
| - | testing. Co | expert insta | Rigidity of Design Shaft with axi based on shaft pl overhang < .006 | · | 2 years but | | End Use | | | years but r | | |
| l | vironment | | Frame Adapter Fits .005- | 5 years | ve been 1 | | | Equipme nt Conditio n Shaft Run out .005- | 700 days | ive been 3 | | |
| - | Very limited controlled environment testing. | | Frame Adapter Fits < | 15 years 5 years | could ha | | | Equipme nt Conditio n Shaft Run out < .004 | 1000 days | e could ha | | |
| | mited cor | | Bearing Housing Fits .010 | 3 years | 1814 limated life | | · | Installati on of pump with H skill level of | 1095 days | limated lif | | |
| | Verv | ì | Bearing Housing Fits .0025 | 10 years | ន្ទ | | | Installati on of Pump with H skill level of | 195 days | Esl | | |
| کر چ | Mfg. of | Assembly | Design | Estimated Life for each item | Assembly Estimated Life | 7 | User of Assembly | Design | Estimated Life for each item | Assembly Estimated Life | | |
| 1804 1 | · | Equipm ent Mfgs Perfor m Laborationy Tests | | | | | | Users perform Real World testing | | | | |
| | | | Tests all pieces in | combination in controlled environment | | | | Invention combines scientists findings with field findings of "H", "O", & | in combination and enables predicted | outcomes | | |
| | က | | | | | | 40 | — | | | | |
| | | | | | EIG | | 18 | ĸ | | | | |

FIG.

18B